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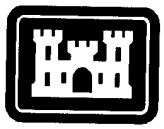

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Potential Impacts of the North Fork Hughes River Project, Ritchie County, West Virginia, 1999, on Freshwater Mussels (Unionidae)

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Contents

Preface

The Natural Resources Conservation Service (NRCS) is providing technical assistance to the Little Kanawha Soil Conservation District and other sponsors in the planning and construction of a multi-purpose dam on the North Fork Hughes River, Ritchie County, WV. As a condition of the 404/401 Permit granted by the U.S. Army Engineer District, Huntington, the permittee was requested to prepare and implement a plan to "quantitatively assess" populations of *Epioblasma triquetra* downstream of the dam prior to construction, 30 days following construction, and every other year for a period of 6 years. Concern had been expressed by resource agency personnel and others that direct and indirect effects of construction could negatively affect *E. triquetra*.

In June 1999, personnel of the U.S. Army Engineer Research and Development Center (ERDC), Vicksburg, MS, conducted a mussel survey in the project area for the NRCS. Work was accomplished by Andrew Miller, William Boyd Green, and Kathryn Barko of the Environmental Laboratory (EL) at the ERDC. Assistance in the field was provided by Mr. Ralph F. Kirchner, U.S. Army Engineer District, Huntington, and Mr. Lynn Shutts, NRCS. Maps and background information on the project area were provided by Mr. Shutts. Suggestions and constructive criticism of the study design for this work was provided by William Tolin, Elkins, WV, of the U.S. Fish and Wildlife Service. Mr. Shutts provided useful commands on a draft of this report.

During the conduct of this study, Dr. John Harrison was Chief, EL; Dr. Conrad J. Kirby was Chief, Environmental Resources Division; and Dr. Alfred F. Cofrancesco was Chief, Aquatic Habitat Group.

At the time of publication of this report, Acting Director of ERDC was Dr. Lewis E. Link. Commander was COL Robin R. Cababa, EN.

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1 Background

Project Information

The Natural Resources Conservation Service (NRCS) is providing technical assistance to the Little Kanawha Soil Conservation District and other sponsors in the planning and construction of a multi-purpose dam on the North Fork Hughes River, Ritchie County, WV. The lake will cover 305 acres and will be used for flood protection, water-based recreation, and water supply. Normal pool elevation following impoundment will be at 712 ft Mean Sea Level (MSL) and the flood pool elevation will be at 737 ft MSL. The reservoir will be designed so that downstream flow will simulate normal operations (stream discharge will equal reservoir outflow) except during periods of high water. During low stream discharge a gate will be used to maintain a minimum flow of 1 cubic ft/sec. Dam construction began in June 1999 and will be completed in approximately 30 months.

Previous Mussel Studies

In 1978 Jenkinson collected 11 species of mussels (Family: Unionidae) at a site upriver of the proposed project although within the area of potential impact (Ohio State Museum:1978:002). A more comprehensive survey was later conducted by Schmidt et al. (1982) who found 16 species from 6 sites located either up- or downriver of the project area. Although no endangered species were found in the North Fork Hughes River, both investigators found a species currently under consideration for listing as endangered, *Epioblasma triquetra* (U.S. Fish and Wildlife Service 1991).

In 1993 the Soil Conservation Service (SCS) contracted with Ecological Specialists, Inc. (ESI) to conduct a mussel survey of the area of potential impact in the North Fork Hughes River. Between 14 and 18 May1993, ESI searched for mussels at 33 sites up- and downriver of the project area. Six sites (Numbers 28 to 33) were located in North Bend State Park and downstream of the project area. Investigators collected by hand and with the aid of viewing buckets. They aged mussels by counting growth annuli.

In 1999 the SCS contracted with the U.S. Army Engineer Waterways Experiment Station (WES), Vicksburg, MS, to conduct additional studies on the mussels immediately downriver of the project area. On 9, 10 June 1999, WES personnel used quantitative and qualitative methods to collect freshwater mussels in a 2-mile reach between the dam site and Bonds Creek. The purpose was to obtain baseline information on community composition, density, and presence of the uncommon bivalve *Epioblasma triquetra*, prior to construction of the dam. Results of additional studies, to be conducted at the same locations after the project has been completed, will be used to assess construction and operation impacts of the dam on *E. triquetra* as well as other freshwater mussels. The same methods will be used to collect mussels after project completion in 2002, and in 2004, 2006, and 2008.

Study Area

The project area is in Ritchie County, northwestern West Virginia. The North Fork Hughes River originates in the northern part of the county near the town of Mountain. It flows in a southwestern direction into North Bend State Park located between Cairo and Harrisville near the center of the county. The North Fork Hughes joins the South Fork Hughes River near Cisco, WV and the Hughes River enters the Little Kanawha River which joins the Ohio River at Parkersburg. The dam site is located in North Bend State Park, approximately 2 miles upriver of the entrance of Bonds Creek (Figure 1).

The North Fork Hughes River lies in the Little Kanawha River Basin, which is within the Appalachian Plateau Physiographic Province. This province is characterized by steep hills, narrow ravines, and ridges. Valleys consist of broad bottoms and terraces of gravel, sand, silt, and clay. Water quality has been described as good, although sedimentation from eroding soils is often a problem (Schmidt et al. 1983).

In 1999 mussels were collected at Sites 28 - 33 of ESI (1993) located downriver of the dam site (See Figure 1-1 of their report). Those investigators chose reaches with riffle, run, chute, or shallow flowing pool habitat likely to support an abundance of mussels. Although the present survey may not have covered the exact locations chosen by ESI, we are certain that we covered many of the same pools and riffles that were surveyed in 1993. We recorded GPS coordinates at all locations where we collected mussels to assist in follow-up studies (Table 1). We did not intensively search for mussels at Site 33 of ESI since they found only a single mussel in 0.5 hours of searching. We searched that site for only a few minutes and found only shells of the Asiatic Clam, *Corbicula fluminea*.

In the project area the North Fork Hughes River ranges from 10 to 25 m wide. Substratum consists mainly of flat rock and cobble, with smaller amounts of sand and gravel. During the survey period water was shallow, rarely more than 0.5 m deep. Pools, riffles and runs characterize the North Fork Hughes River, with

extensive areas of water willow (*Justica americana*) in some areas. Water was virtually stationary in the pools but ranged from 25 to 50 cm/sec in the riffles and runs. Banks were steep and well-vegetated.

Methods

Mussels were collected using both quantitative and qualitative methods. On 9 June 100 total substratum $0.25m^2$ quadrat samples were obtained at 8 locations in the project area (Table 2). These were collected by haphazardly placing a quadrat in the study reach and then excavating all mud, sand, gravel, live mussels and shells. Substratum was sieved and all live mussels, and the Asiatic clam *Corbicula fluminea*, were removed, identified, and total shell length measured. All mussels were then returned to the river unharmed. More information on this sampling method can be found in Miller and Payne (1993). Mussel nomenclature followed Williams et al. (1993).

Total substratum sampling has the advantage of providing good estimates of density and population size structure since all mussels are collected without bias as to size, shape, or appearance. Because it is time-consuming and samples a very small area, this method does not usually provide an extensive species list, especially in areas with comparatively low density.

On 10 June qualitative methods were used to collect mussels. This was done by measuring an area and then collecting all live mussels that were either seen or felt. Using this method we were able to estimate the number of mussels collected per area and the number collected per minute. We avoided all *Corbicula fluminea;* if they were obtained we deleted them from the samples. Qualitative methods cover a large area and provide a good species list, although there will be some bias toward larger and more easily observed individuals.

2 Results and Discussion

Community Characteristics

Using qualitative and quantitative methods, a total of 17 and 13 species of native mussels, in addition to the nonindigenous *Corbicula fluminea*, was collected from the project area (Table 3). The majority of the mussels (786) were collected using qualitative methods; only 58 individuals were taken using the quantitative quadrat sampling. With both collections combined, a total of 19 species and more than 800 native mussels were found.

Based upon the quadrat sampling, mean mussel density ranged from 0.0 to a maximum of 4.8 individuals/m^2 (Table 4). Overall density in the project area was estimated at 0.23 individuals/m^2. Four species *(Lampsilis siliquoidea, Amblema p. plicata, Elliptio dilatata,* and *Fusconaia flava*) each comprised more than 10% of the quantitative collection (Table 5). The remaining 9 species each comprised from 1 to less than 10% of the collection.

Over 15,000 sq m were searched using qualitative methods (Table 6). More than 700 mussels were taken and a total of 705 min (11.75 hr) were spent collecting. Mussels were obtained at a rate of 0.23 to 2.25 individuals/min with an overall average of 1.11 mussels/min. Density estimates ranged from 0.01 to 0.54, with an overall mean of 0.05 mussels/m^2 using this method.

Composition of the mussel fauna characterized by the qualitative collecting was less evenly distributed than that determined via quadrat sampling (compare Table 7 with Table 5). Only two species comprised more than 10% of the fauna (*Lampsilis siliquoidea* and *Amblema p. plicata*). Nine species comprised from 1 to 10% of the fauna and 6 species made up less than 1% of the total collection.

Demography of Abundant Populations

All mussels in the quantitative and qualitative collections were measured in the field. The samples were combined for the following demographic analyses. All populations of the most abundant species showed only a little evidence of recent recruitment based on individuals obtained during qualitative searches.

Populations were dominated by moderately large to large individuals and included just a few small to moderate sized mussels.

The most abundant species, *Lampsilis siliquoidea*, ranged in length from 40 to 135 mm (Figure 2a). More than 50% of the population was 85 to 115 mm long. Only three individuals were less than 50 mm long. No moderate or small-sized mussels were obtained in the sample of the *A. p. plicata* population (Figure 2b). Individuals of this species ranged from 90 to 152 mm. Thus, this population was comprised only of large, old individuals.

Elliptio dilitata, and elongate mussel, ranged from 55 to 175 mm (Figure 3a). All but two mussels were included within the range of 85 to 140 mm. The largest mussel, measuring 175 mm, was exceptionally large. The smallest mussel (55 mm) was a reasonably recent recruit to the population. Another elongate mussel, *Tritogonia verrucosa*, ranged from 66 to 172 mm (Figure 3b). Most of the population was 105 to 160 mm long. Six individuals less than 80 mm long were obtained. Given the elongate nature of this species, these six individuals represented somewhat recent recruitment. *Lasmigona costata*, another somewhat elongate species, ranged from 88 to 146 mm (Figure 4a). All but two individuals were less than 130 mm long. This population showed no evidence of recent recruitment.

Potamilus alatus ranged from 88 to 190 mm long (Figure 4b). Although individuals less than 100 mm long of this laterally compressed, alate species are moderately young, very recent recruits measure less than 50 mm. No such recent recruits were present in this population. A single recent recruit of *Lampsilis cardium* was obtained, measuring 25 mm long (Figure 5a). Otherwise this population was comprised of individuals 85 to 140 mm long. Such a size range includes moderately large and large adults of this species.

Pytchobranchus fasciolaris measured 94 to 136 mm long (Figure 5b). This length range includes moderately large and large adults. No recent recruits were evident. *Fusconaia flava* ranged from 40 to 96 mm long (Figure 6). Individuals less than 50 mm are reasonably recent recruits. However, recruits within the last 2-3 years almost certainly would measure less than 30 mm.

For all species, individuals obtained during quantitative substratum sampling reflected the same size structure as indicated from qualitative searches. Nearly all individuals collected by quantitative methods fell withing the length range that encompasses most individuals collected sem-quantitatively. There was no evidence that recent recruits were under-represented in qualitative samples. In summary, population size structure indicated dominance or exclusive representation of moderately large to large adults. A few moderately young individuals were obtained of several species, and one very young mussel was found in the *Lampsilis cardium* population. These results indicate that recruitment occurs at a very low rate in these populations.

Comparison with Previous Surveys

Schmidt et al. (1983) collected 16 species of mussels at 6 sites up- or downriver of the river reach that we studied (Table 8). All of the species collected by those workers were found during the present survey, with the exception of *Pyganodon grandis*. This species typically is found in fine-grained substratum in ponds, rivers, or streams with reduced water velocity and is not likely to be common to abundant in gravel or cobble substratum that characterizes this project area.

ESI (1993) collected 18 species of mussels and over 1,200 individuals using qualitative methods at 5 sites in the project area (Table 9). Their species list was virtually identical to the one developed from this survey. One specimen of *Quadrula quadrula* was collected by those workers in 1993 but not in 1999. Three species were collected in the project area in 1999 but not in 1993: *Fusconaia subrotunda , Toxolasma parva*, and *Elliptio crassidens.* During their survey ESI (1993) found two of these three species, *Fusconaia subrotunda and Toxolasma parva,* upriver of the project area.

Percentage abundance of the 10 most abundant species collected during the 1993 and 1999 surveys using qualitative methods is shown in Figure 7. *Lampsilis siliquoidea* dominated in 1993, and numbers of *Amblema p. plicata* and *Tritogonia verrucosa* were greater in 1999. Substantially fewer *Leptodea fragilis*, *Obovaria subrotunda*, and *Epioblasma triquetra* were taken in 1999 as compared with 1993. However, the species lists summarizing these three surveys (Schmidt et. al (1983), ESI (1993), and our work in 1999) illustrate that there have been no major shifts in the molluscan fauna.

Quantitative methods were not used in any of the previous surveys, so it is not possible to compare density or evidence of recent recruitment in 1999 with that of the previous years. With respect to density, values in the project area, less that 5 individuals/m^2, can be considered low. This number is substantially lower than values in large rivers, where density typically varies between 50 and 100 individuals/m^2 (Miller et al. 1992a,b).

ESI (1993) reported collecting some young individuals (i.e. evidence of recent recruitment) for 11 of the 18 mussel species in the river (Table 9). This assessment was based upon all mussels collected from the river and does not refer only to those collected in the project area, Sites 28-32. We found no mussels less than 30 mm total shell length (Table 5), which is the size of mussels that would be 1 - 3 years old (Payne and Miller 1989). However, small individuals of many species were collected (see Figures 2a, 3a, 3b, 4b, 5a, and 6). The minimum and maximum shell lengths of all mussels collected (regardless of technique) are listed in Table 3. We found that 10 of 19 species had at least one individual less than or equal to 0.60 the length of the largest individual of that species.

ESI (1993) reported collecting 41 *Epioblasma triquetra* (3.18%) in the project area. In our survey only 3 individuals were collected when results of qualitative (786 individuals) and quantitative sampling (58 individuals) are combined. Differences in collecting methods, or habitats surveyed, could explain some of the differences although it is also likely that some of those collected in 1993 had died when the area was re-surveyed in 1999. Maximum shell length of males and females has been listed as approximately 70 and 45 mm, respectively (Parmalee and Bogan 1998). The three specimens collected during this survey were 45.6, 50.0, and 52.3, mm total shell length. Three dead individuals, of the same approximate lengths, were also collected. It is possible that many of those collected in 1993 had died, and the population has not fully recovered.

Project Impacts

The river reach downstream of the project area could be affected by dam construction. This could include altered flow and sediment deposition resulting from earth movement, placement of the coffer dam, and flow diversion. However, once completed, project impacts on mussels should be minor. The dam has been designed to remove water from the surface of the lake, consequently, there should be no downstream problem associated with reduced oxygen, low temperatures, or elevated nutrients that often accompany hypolimnetic releases. In fact, increased plankton and particulate organic matter from the small lake could increase filterable food supplies that are important in bivalve nutrition. In addition, the project has been designed to reduce the chances of extreme low flow downriver of the dam. During low discharge a minimum flow of 1 cubic ft/sec will be maintained.

Creation of the lake will convert the river to a deep, slack-water habitat unlikely to support riffle species. Only unionids that tolerate lentic conditions (such as *Pyganodon grandis, Utterbackia imbecillis, Toxolasma parvus, Lampsilis siliquoidea, Amblema p. plicata,* and possibly *Quadrula quadrula*) are likely to survive in the new lake.

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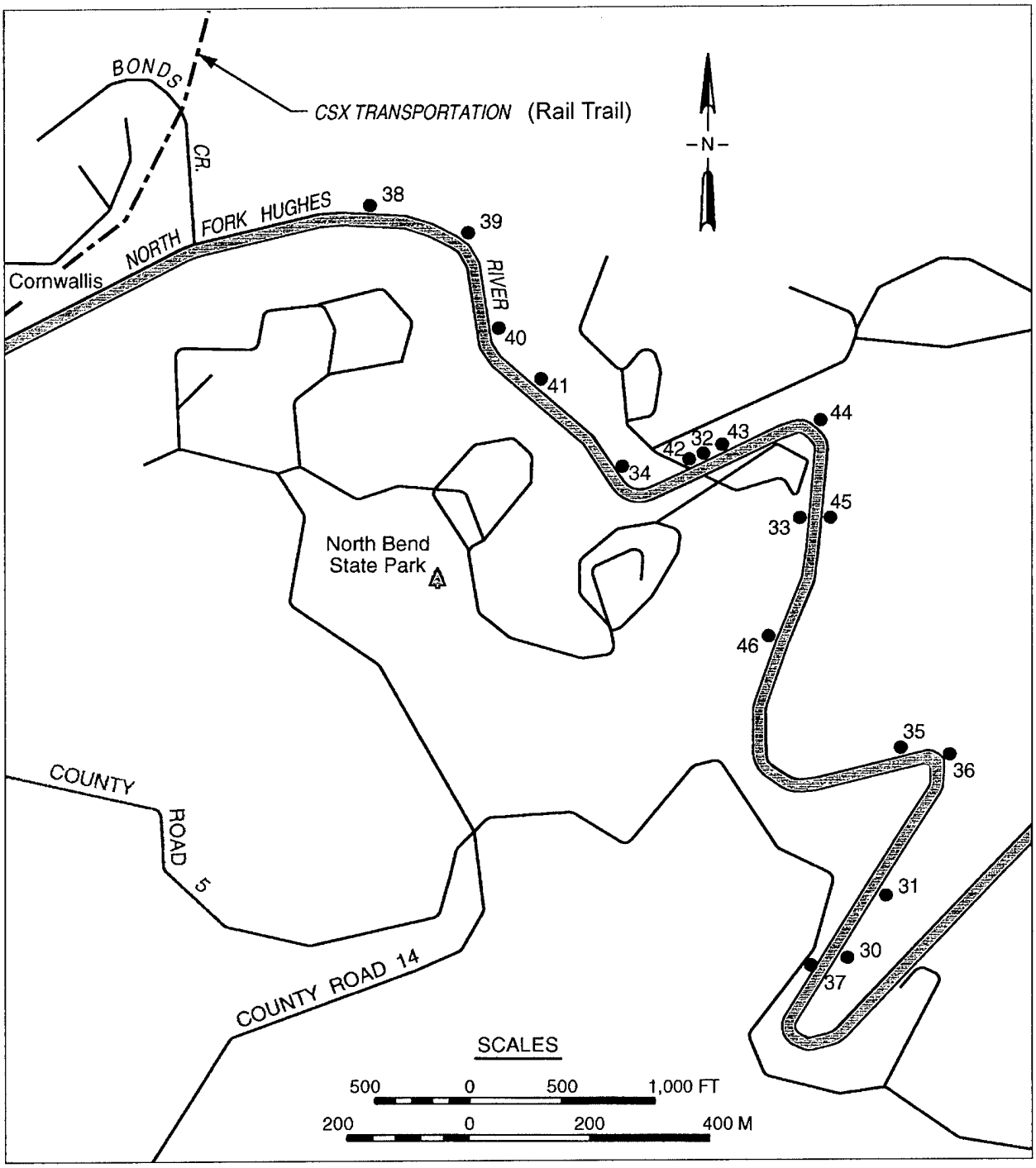

Figure 1. Map of the project area. GPS Waypoints (Table 1) identify sites where mussels were collected

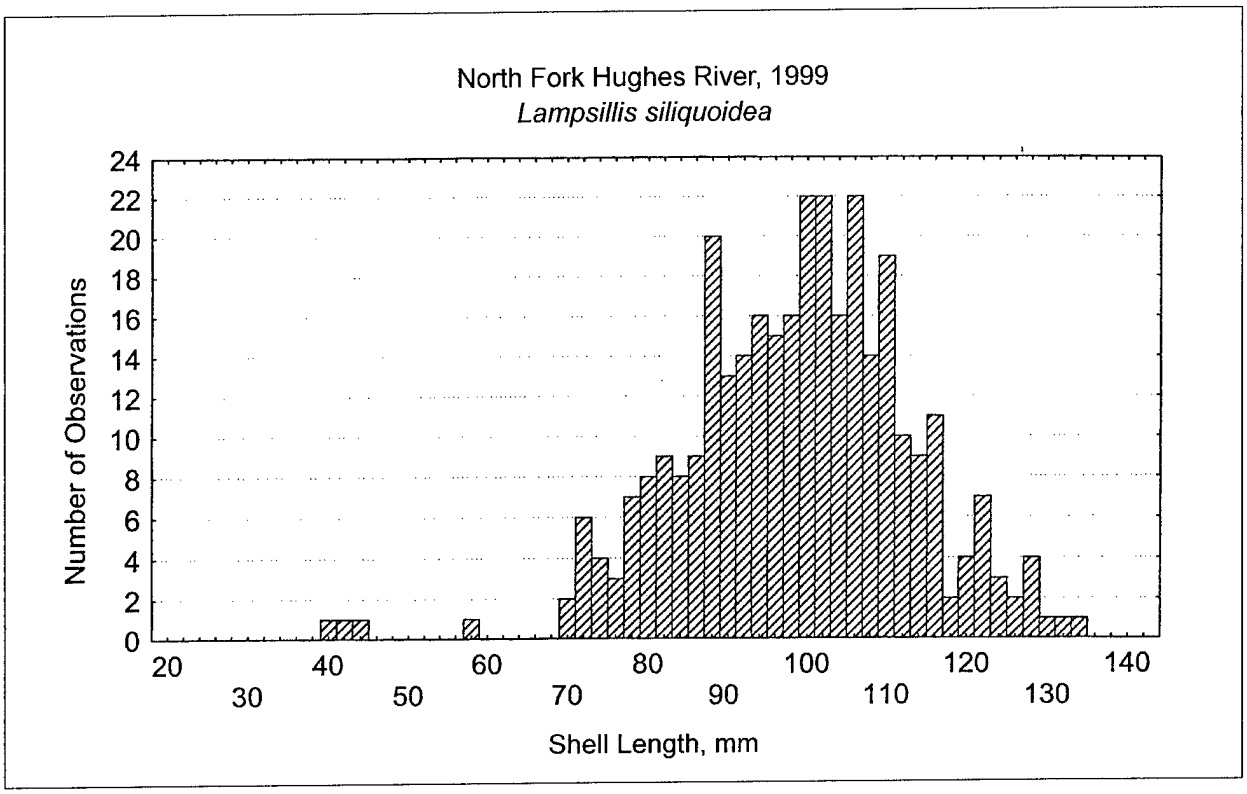

Figure 2a. Size frequency analysis for *Lampsilis siliquoidea*

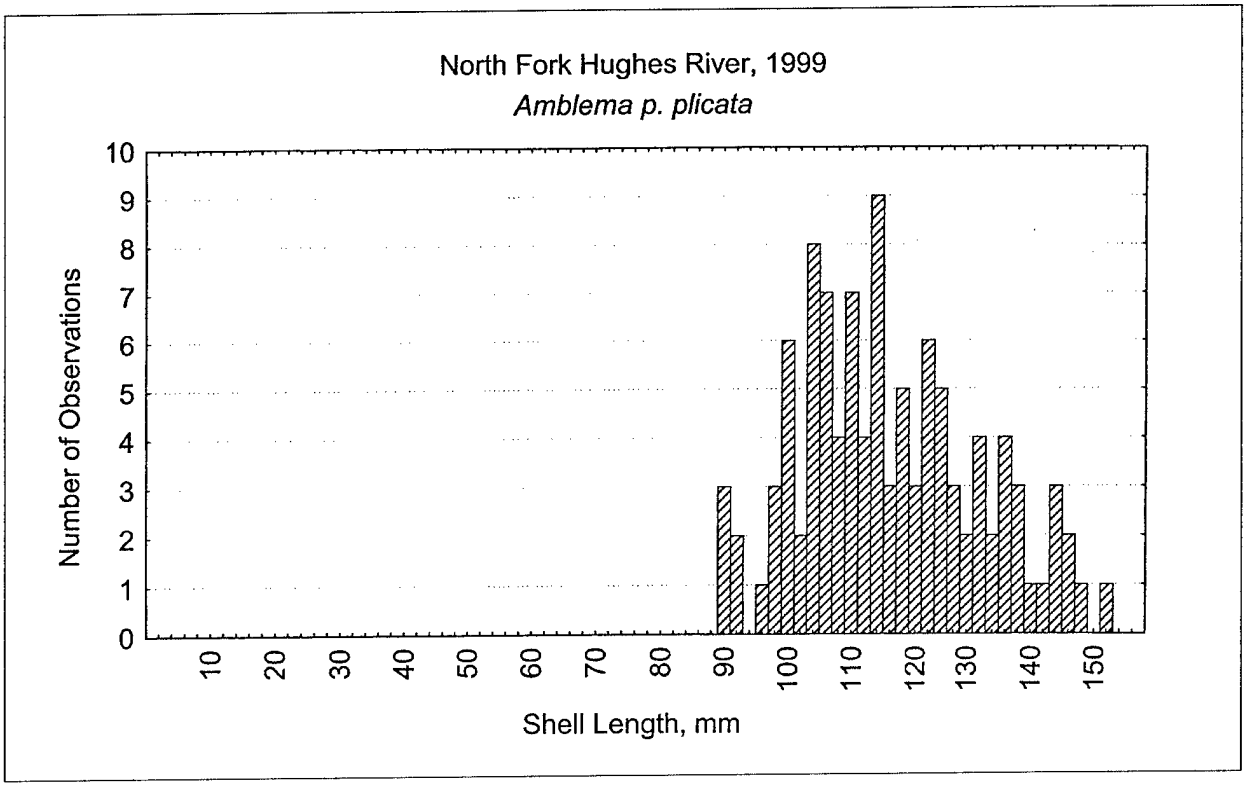

Figure 2b. Size frequency analysis for *Amblema p. plicata*

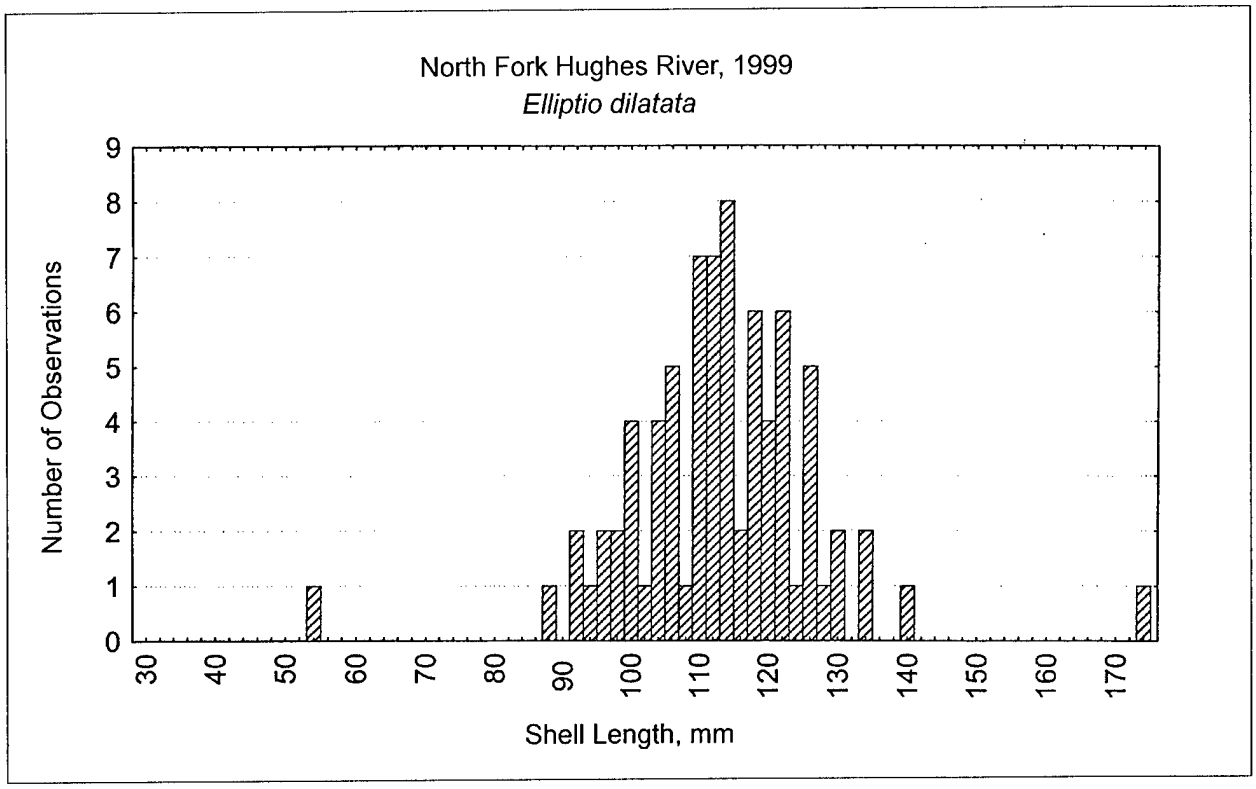

Figure 3a. Size frequency analysis for *Elliptio dilatata*

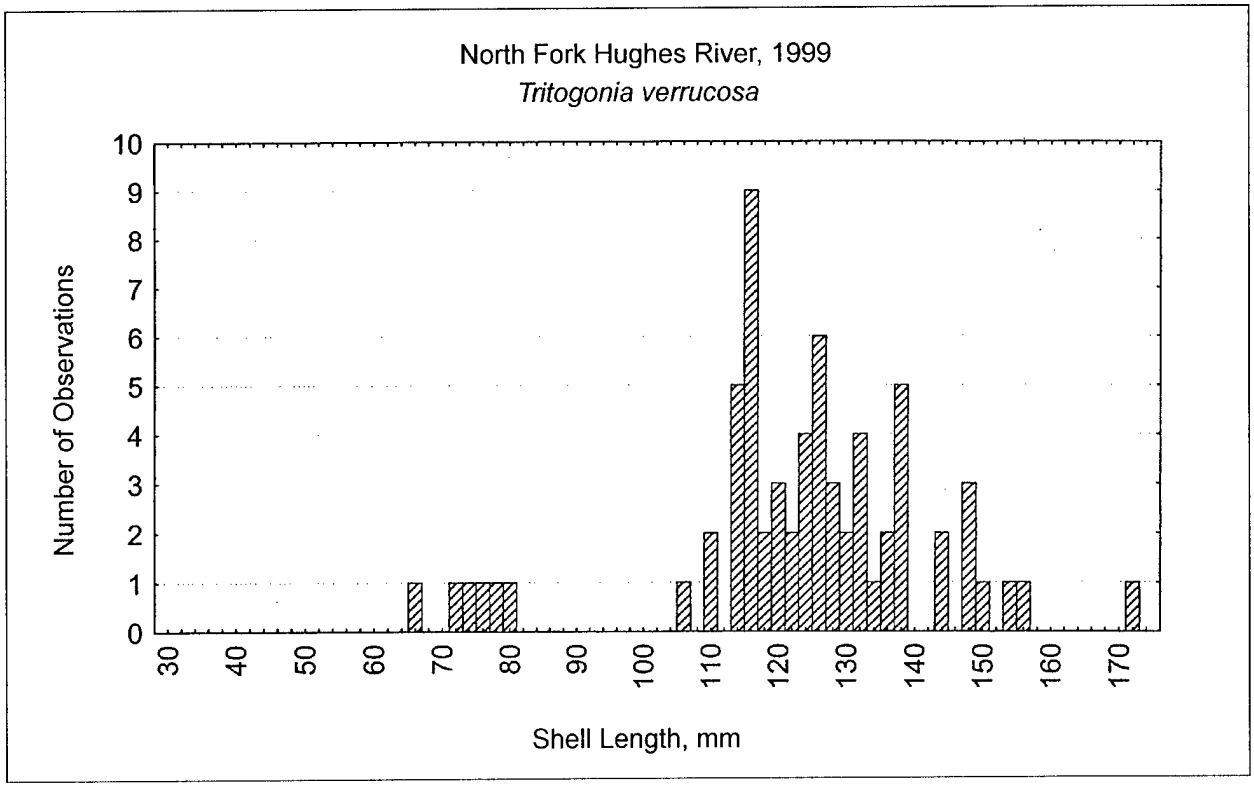

Figure 3b. Size frequency analysis for *Tritogonia verruscosa*

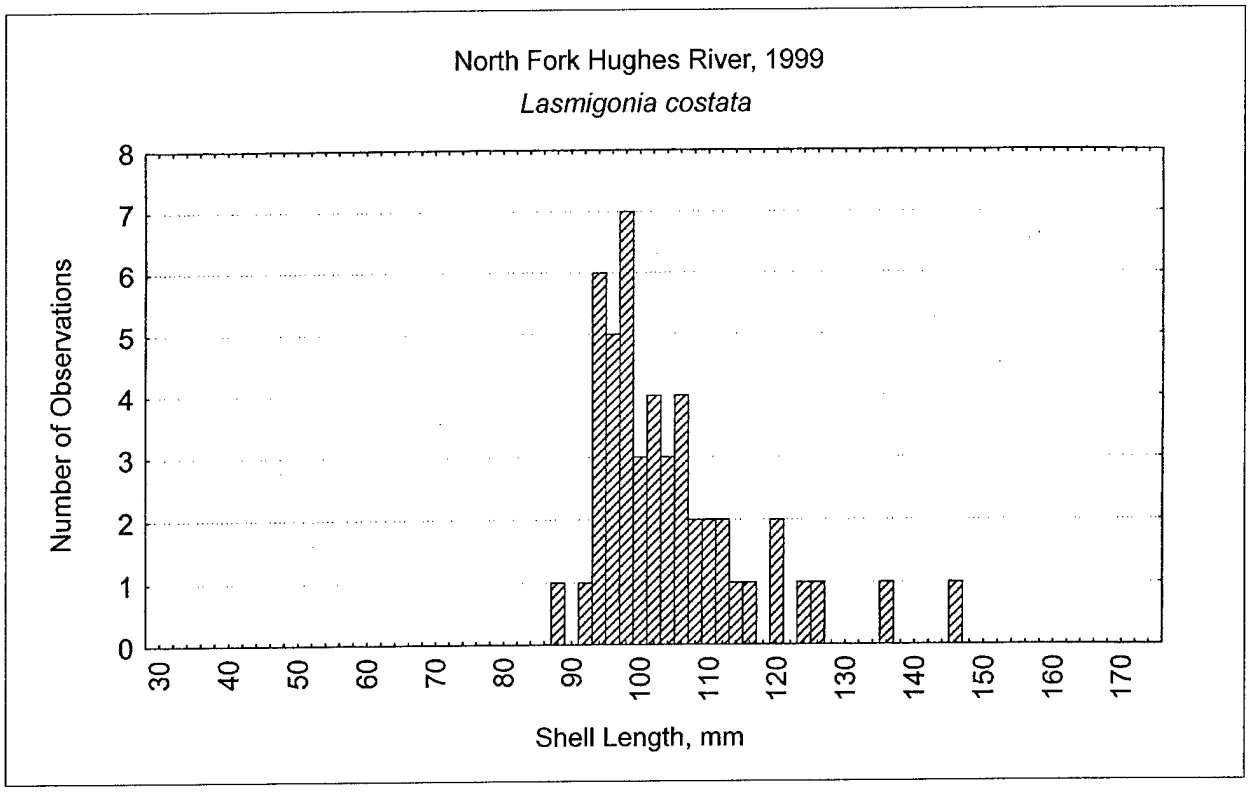

Figure 4a. Size frequency analysis for *Lasmigonia costata*

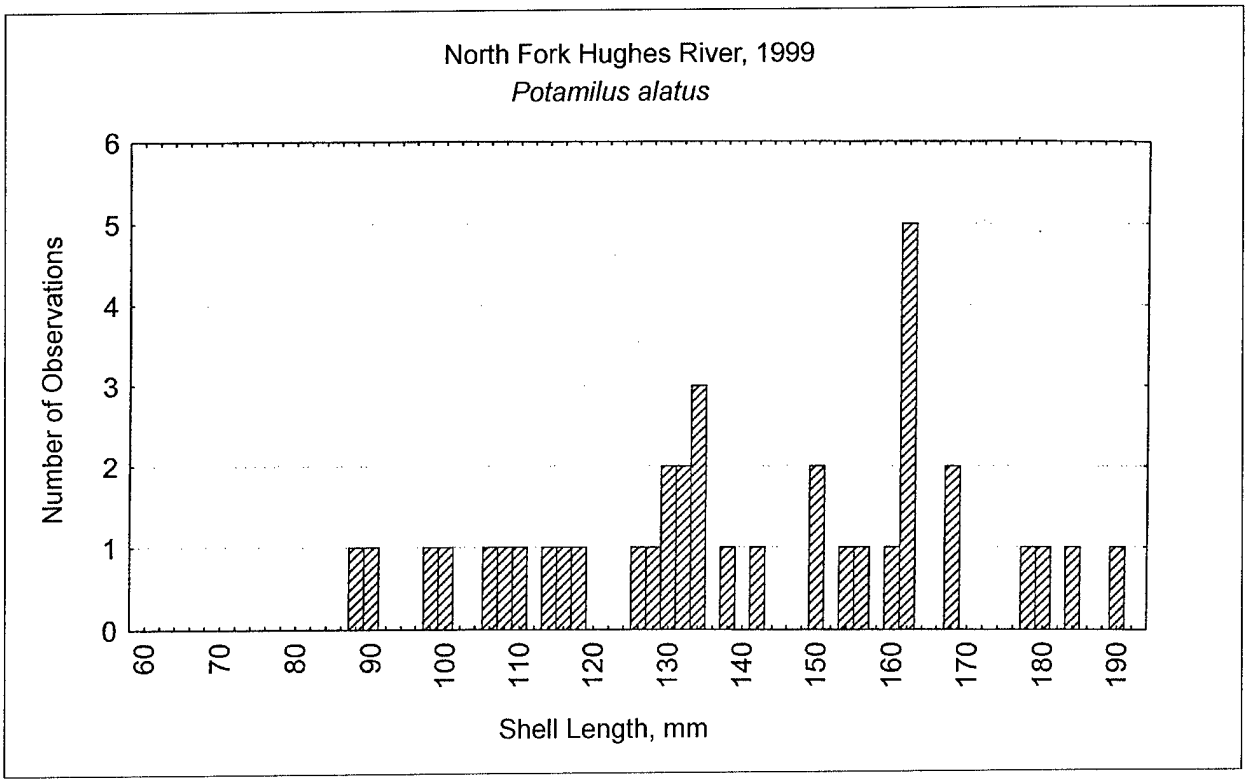

Figure 4b. Size frequency analysis for *Potamilus alatus*

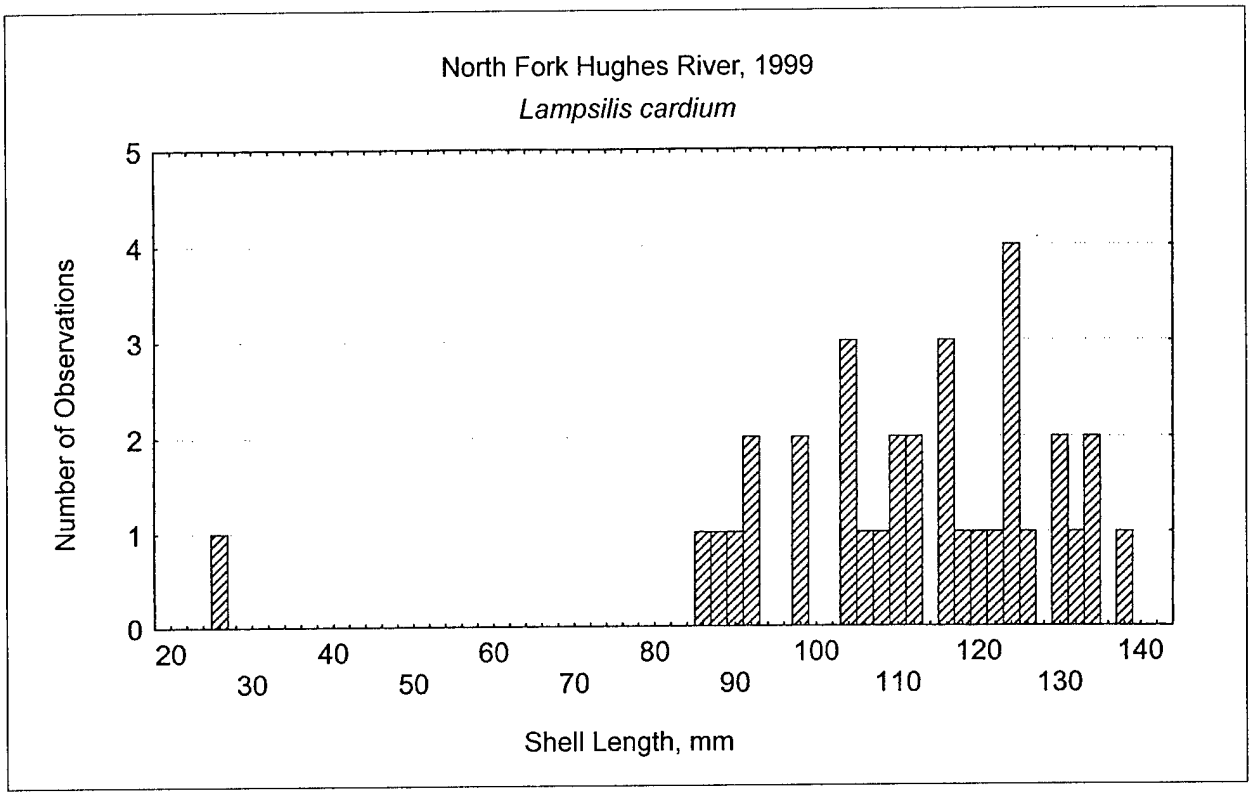

Figure 5a. Size frequency analysis for *Lampsilis cardium*

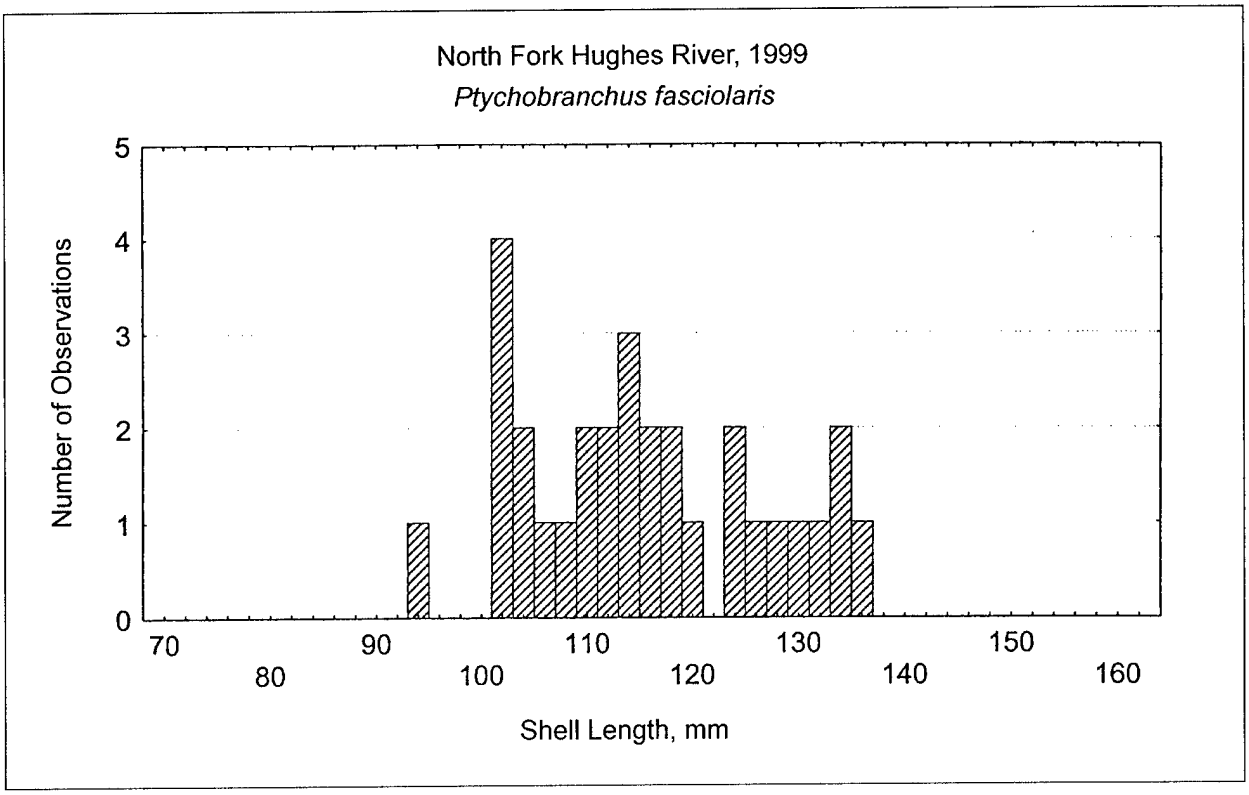

Figure 5b. Size frequency analysis for *Ptychobranchus fasciolaris*

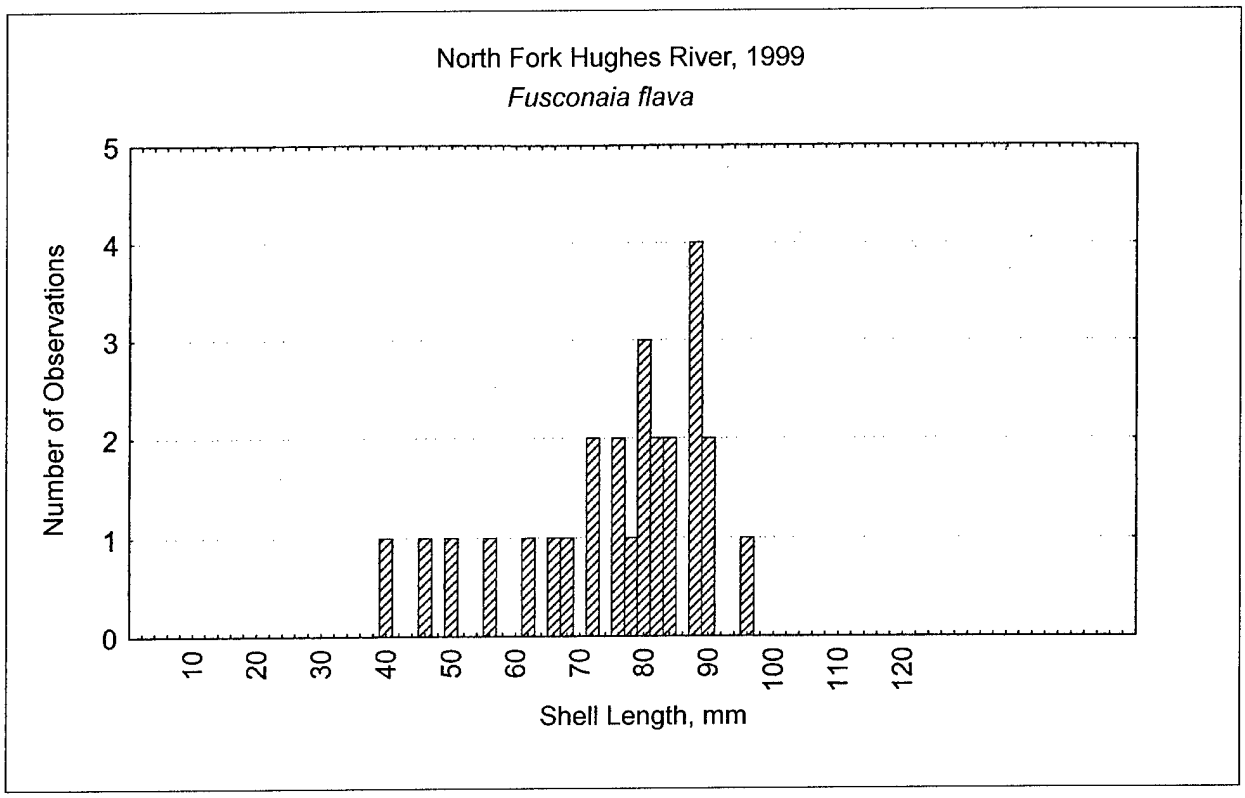

Figure 6. Size frequency analysis for *Fusconaia flava*

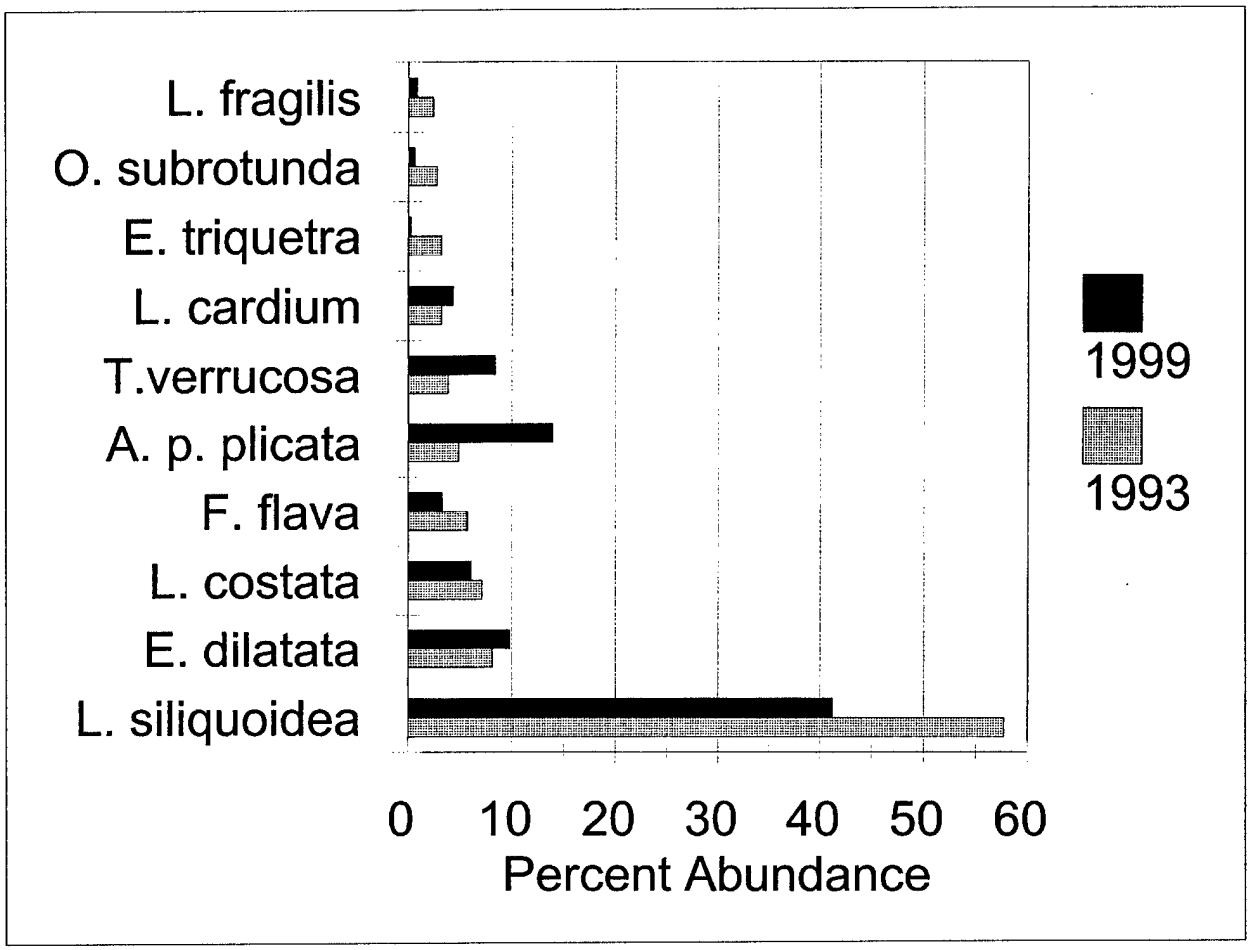

Figure 7. Percent abundance for 10 common species collected in 1993 by ESI (1993) and this survey in the river reach below the dam site

Table 1
Coordinates for Collection Sites, North Fork Hughes Reservoir Project, June 1999.
Some WayPoints Correspond to Sites Studied by ESI (1993); see Table 2, Figure 1

			Converted Longitude		Converted Latitude	
GPS Longitude	GPS Latitude	WayPoint	Deg	Min	Deg	Min
39.217731	-81.102458	30	39	13.355	81	6.706
39.218338	-81.101284	31	39	13.064	81	6.147
39.225698	-81.10572	32	39	13.100	81	6.077
39.224222	-81.103451	33	39	13.542	81	6.343
39.225129	-81.106535	34	39	13.453	81	6.207
39.221014	-81.10131	35	39	13.508	81	6.392
39.220671	-81.100409	36	39	13.261	81	6.079
39.217495	-81.10278	37	39	13.240	81	6.025
39.229029	-81.111589	38	39	13.050	81	6.167
39.228895	-81.109786	39	39	13.742	81	6.695
39.226996	-81.109201	40	39	13.734	81	6.587
39.2264	-81.108263	41	39	13.620	81	6.552
39.225102	-81.105677	42	39	13.584	81	6.496
39.225306	-81.105071	43	39	13.506	81	6.341
39.225751	-81.102968	44	39	13.518	81	6.304
39.22419	-81.102914	45	39	13.545	81	6.178
39.22242	-81.104706	46	39	13.451	81	6.175

Table 2
Summary Information on sample Site Location for Quantitative, Total Substratum Samples Collected in the North Fork Hughes River Project Site, 9 June 1999. Site Numbers Follow Those of ESE (1993)

Site	Waypoint	Notes
28	30	Approximately 100 m downstream of low-water bridge, water pooled and 0.2 m deep
28	31	Small pool immediately downstream of first set
28	35	At the extreme downstream, RDB, portion of #28, small chute.
30	33	Immediately off tent site # 17
30	33	Upstream of tent site #17 and between tent sites 13 and 14
31	32	Immediately upstream of the most upstream willow shoal
31	34	Downstream and along center and LDB of the second downstream shoal
31	34	Upstream and along the RDB of the second willow shoal

Table 3
Summary of Freshwater Mussel Species Collected Using Qualitative and Quantitative Methods, North Fork Hughes River Project, 9-10 June 1999. Minimum and Maximum Shell Length Data Include Mussels Collected Using Both Qualitative and Quantitative Methods

Species	Qualitative Samples	Quantitative Samples	Shell Length, mm		
			Minimum	Maximum	Min/Max
Amblema p. plicata	x	x	84.38	146.90	0.57
Elliptio crassidens	x		114.50	114.50	1.00
Elliptio dilatata	x	x	53.90	173.50	0.31
Epioblasma triquetra	x	x	45.60	52.30	0.87
Fusconaia flava	x	x	39.10	95.90	0.41
Fusconaia subrotunda	x	x	90.10	115.50	0.78
Lampsilis siliquoidea	x	x	39.10	132.30	0.30
Lampsilis cardium	x	x	24.80	145.75	0.17
Lasmigonia costata	x	x	86.90	144.90	0.60
Leptodea fragilis	x		101.60	174.40	0.58
Obovaria subrotunda	x		28.80	66.80	0.43
Pleurobema sintoxia		x	32.31	35.24	0.92
Ptychobranchis fasciolaris	x	x	93.50	135.70	0.69
Potamilus alatus	x	x	86.30	188.58	0.46
Quadrula quadrula	x		99.10	111.90	0.89
Strophitus undulatus	x		69.10	93.10	0.74
Tritogonia verrucosa	x	x	64.30	170.60	0.38
Toxolasma parva	x		49.70	49.70	1.00
Villosa iris		x	50.38	70.11	0.72
Total species	17	13			
Total individuals	786	58			

Table 4
Number of Quantitative Samples Collected at Various Locations in the North Fork Hughes River Project Area, 9 June 1999. See Figure 1 for Location of Waypoints

Waypoint	No of 0.25 sq m Samples	Total mussels	Density, No./sq m
30	10	1	0.4
31	10	0	0
35	20	20	4
33	10	3	1.2
33	10	2	0.8
32	20	24	4.8
34	10	1	0.4
34	10	7	2.8
Total samples	100		
Total species		58	

Table 5
Freshwater Mussels Collected in 100 Quantitative Samples at Eight Locations in the North Fork Hughes River, 9 June 1999

Species	Number	Percentage
Lampsilis siliquoidea	12	20.69
Amblema p. plicata	8	13.79
Elliptio dilatata	7	12.07
Fusconaia flava	6	10.34
Lampsilis cardium	5	8.62
Lasmigona costata	5	8.62
Pleurobema sintoxia	3	5.17
Tritogonia verrucosa	3	5.17
Ptychobranchus fasciolaris	3	5.17
Villosa iris	2	3.45
Potamilus alatus	2	3.45
Fusconaia subrotunda	1	1.72
Epioblasma triquetra	1	1.72
Total individuals	58	
Total species	13	
% Individuals < 30 mm SL	0	
% Species < 30 mm SL	0	

Table 6
Number of Mussels Collected at Selected Sites in the North Fork Hughes Reservoir Project, June 1999, Using Qualitative Methods. Sample Site Locations Follow Those of ESE (1993)

Site	Total Time	Total Mussels	Area, sq m	Mussels/min	Mussels/sq m	Waypoint	
						Lower	Upper
28	48	34	261	0.71	0.13	36	
28	28	63	116	2.25	0.54		
28	24	35	218	1.46	0.16		
28	36	20	740	0.56	0.03		
28	125	98	2,831	0.78	0.03		37
29	64	75	3,600	1.17	0.02	45	46
30	80	129	1,132	1.61	0.11	44	45
31	120	227	2,613	1.89	0.09	42	43
32	75	17	1,672	0.23	0.01	39	38
32	105	88	2,195	0.84	0.04	40	41
Total	705	786	15,378	1.11	0.05		

Table 7
Percent Abundance of Freshwater Mussels Collected in Qualitative Collections in the North Fork Hughes River Project, 10 June 1999

Species	Site Number					Total
	28	29	30	31	32	
L. siliquoidea	58.80	34.67	21.71	44.05	21.90	41.22
A. p. plicata	8.40	8.00	17.05	16.74	17.14	13.36
E. dilatata	3.60	13.33	11.63	9.25	20.95	9.80
T. verrucosa	6.40	9.33	11.63	6.17	13.33	8.40
L. costata	3.60	10.67	15.50	4.41	0.95	6.11
P. alatus	3.20	5.33	2.33	5.29	9.52	4.71
L. cardium	3.20	9.33	6.98	3.96	0.95	4.33
P. fasciolaris	0.40	5.33	6.20	5.73	3.81	3.82
F. flava	6.40	2.67	1.55	2.64	0.00	3.31
F. subrotundata	0.80	1.33	1.55	0.00	6.67	1.53
S. undulatus	3.20	0.00	0.00	0.00	0.95	1.15
L. fragilis	0.00	0.00	1.55	1.32	1.90	0.89
O. subrotundata	1.20	0.00	0.78	0.44	0.00	0.64
E. triquetra	0.40	0.00	0.78	0.00	0.00	0.25
T. parva	0.00	0.00	0.78	0.00	0.00	0.13
Q. quadrula	0.40	0.00	0.00	0.00	0.95	0.25
E. crassidens	0.00	0.00	0.00	0.00	0.95	0.13
Total species	14	10	14	11	13	17
Total individuals	250	75	129	227	105	786
Total time, min	261	64	80	120	180	705
Individuals/min	0.96	1.17	1.61	1.89	0.58	1.11
Total area, sq m	4,116	3,600	1,132	2,613	3,867	15,378
Estimated density, /sq m	0.06	0.02	0.11	0.09	0.03	0.05

Table 8
Species of Freshwater Mussels Collected in the North Fork Hughes River, 1981-82 (taken from Schmidt et al. 1983)

Amblema p. plicata
Elliptio dilatata
Epioblasma triquetra
Fusconaia flava
Lampsilis ventricosa (probably L. cardium)
Lampsilis radiata leuteola (probably L. siliquoidea)
Lasmigona costata
Leptodea fragilis
Obovaria subrotunda
Pleurobema coccineum (=sintoxia)
Potamilus alatus
Ptychobranchis fasciolaris
Pyganodon grandis
Strophitus undulatus
Tritogonia verrucosa
Villosa iris
Total species = 16

Table 9
Percent Abundance of Freshwater Mussel Species Collected at 5 Sites in the North Fork Hughes Reservoir Project Area, May 1993 by Ecological Specialists, Inc. (1993). Young Individuals of Species Listed with an "R" were Observed in the Study Area and Not Necessarily from Sites 28-32

Species	Recruit	28	29	30	31	32	Total
L. siliquoidea	R	63.14	55.45	40.71	57.09	47.65	52.72
E. dilatata	R	6.09	12.27	9.44	4.86	8.82	8.15
L. costata	R	5.13	2.73	11.80	6.48	8.24	7.14
F. flava	R	4.49	7.73	5.31	4.45	8.24	5.75
A. plicata		5.13	5.91	4.72	4.86	3.53	4.89
T. verrucosa		1.28	2.27	6.19	3.24	7.06	3.88
L. cardium	R	2.88	1.36	5.60	2.43	2.35	3.18
E. triquetra	R	0.32	6.36	4.42	4.05	0.59	3.18
O. subrotunda	R	3.85	0.91	1.77	2.02	6.47	2.80
L. fragilis		3.21	0.00	3.54	1.21	3.53	2.41
P. fasciolaris	R	0.32	3.64	1.18	2.02	2.35	1.71
P. coccineum (=sintoxia)		0.00	0.45	2.65	2.43	0.00	1.24
P. alatus	R	2.24	0.00	0.30	1.62	0.59	1.01
S. undulatus	R	1.28	0.91	1.77	0.00	0.00	0.93
P. grandis	R	0.64	0.00	0.59	1.62	0.00	0.62
U. imbecillis		0.00	0.00	0.00	1.21	0.00	0.23
Q. pustulosa		0.00	0.00	0.00	0.40	0.00	0.08
Q. quadrula		0.00	0.00	0.00	0.00	0.59	0.08
Total individuals		312	220	339	247	170	1,288
Total species		14	12	15	16	13	18
Time (min)		240	120	120	120	90	690
Individuals/min		1.30	1.83	2.83	2.06	1.89	1.87

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13. ABSTRACT ***(Maximum 200 words)***

On 9 and 10 June 1999, a survey for freshwater mussels (Family: Unionidae) was conducted along a reach of the North Fork Hughes River, Ritchie County, WV. The purpose was to obtain baseline data on density, relative abundance, species composition, and recent recruitment for freshwater mussels. The study area was immediately below a reservoir project that began later that month and was scheduled for completion in 2002. Additional studies will be conducted in 2002, 2004, 2006, and 2008.

Using qualitative and quantitative methods, a total of 17 and 13 species of native mussels, in addition to the nonindigenous *Corbicula fluminea*, was collected from the project area. Based upon the quadrat sampling, mean mussel density ranged from 0.0 to a maximum of 4.8 individuals/m^2; overal density was estimated at 0.23 individuals/m^2. Using qualitative methods, more than 700 mussels were taken. Two species comprised more than 10 percent of the assemblage (*Lampsilis siliquoidea* and *Amblema plicata plicata*), nine species comprised from 1 to 10 percent of the fauna and six species made up less than 1 percent of the total collection.

Overall, the fuana was dominated by adult and sub-adult-sized mussels; none were less than 30 mm in total shell length, indicating that recruitment occurs at a very low rate. There have been no major unexplained shifts in the molluscan fauna in

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the study area based upon findings from two former surveys. Results of future studies, to be conducted after the lake is finished, will be used to evaluate project impacts.